Nortel Ethernet Routing Switch 4500 Series

Installation — SFPs and XFPs

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New in this release

The following sections detail what's new in *Nortel Ethernet Routing Switch 4500 Series Installation — SFPs and XFPs* (NN47205-301) for Release 5.2.

- "Features" (page 5)

Features

See the following sections for information about feature changes:

New SFPs

Release 5.2 supports four new SFPs. See the following for more information:

- "1000BASE-BX DDI SFP specifications" (page 44)
- "1000BASE-SX DDI SFP specifications" (page 43)
- "1000BASE-LX DDI SFP specifications" (page 44)

New XFPs

Release 5.2 supports two new XFPs. See the following for more information:

- "10GBASE-LR/LW XFP specifications" (page 52)
- "10GBASE-LRM XFP specifications" (page 50)

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Introduction

This document describes how to select, install, and remove an SFP or XFP. It also provides specifications for each device.

Navigation

- “Safety and equipment care information” (page 9)
- “Small form factor pluggable transceivers” (page 21)
- “10 Gigabit small form factor pluggable transceivers” (page 29)
- “SFP specifications” (page 35)
- “XFP specifications” (page 47)

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Safety and equipment care information

This section contains important safety and regulatory information. Read this section before you install Small Form Factor Pluggable (SFP) transceivers or 10 Gigabit SFP (XFP) transceivers.

Navigation

- "Handling, safety, and environmental guidelines" (page 9)
- "Care of fiber optic equipment" (page 10)
- "Product safety warnings and information" (page 16)

Handling, safety, and environmental guidelines

Before you install an SFP or XFP, read the following handling, safety, and environmental guidelines:

- SFPs and XFPs are static sensitive. To prevent damage from electrostatic discharge (ESD), see "Electrostatic discharge prevention" (page 9).
- SFPs and XFPs use optical parts whose performance can be reduced by dust contamination. When you store an SFP or XFP, or when you disconnect it from a fiber optic cable, always keep a dust cover over the optical bore.
- Dispose of this product according to all national laws and regulations.

Electrostatic discharge prevention

To prevent equipment damage, observe the following electrostatic discharge (ESD) precautions when handling or installing the components.

- Ground yourself and the equipment to an earth or building ground. Use a grounded workbench mat (or foam that dissipates static charge) and a grounding wrist strap. The wrist strap should touch the skin and be grounded through a one megaohm resistor.
- Do not touch anyone who is not grounded.

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- Leave all components in their ESD-safe packaging until installation, and use only a static-shielding bag for all storage, transport, and handling.
- Clear the area of synthetic materials such as polyester, plastic, vinyl, or styrofoam because these materials carry static electricity that damages the equipment.

Care of fiber optic equipment

Fiber optic equipment connections must be kept clean and damage-free. Use the information in this section to properly maintain and care for fiber optic equipment.

Care of fiber optic equipment navigation

- "Fiber optic cable care" (page 10)
- "Fiber optic connector care" (page 11)
- "Cleaning single connectors" (page 12)
- "Cleaning duplex connectors" (page 13)
- "Cleaning receptacles" (page 14)

Fiber optic cable care

Although the glass fiber in fiber optic cable is protected with reinforcing material and plastic insulation, it is subject to damage. Use the following precautions to avoid damaging the glass fiber.

- Do not kink, knot, or vigorously flex the cable.
- Do not bend the cable to less than a 40 mm radius.
- Do not stand on fiber optic cable; keep the cable off the floor.
- Do not pull fiber optic cable any harder than you would a cable containing copper wire of comparable size.
- Do not allow a static load of more than a few pounds on any section of the cable.
- Place protective caps on fiber optic connectors that are not in use.
- Store unused fiber optic patch cables in a cabinet, on a cable rack, or flat on a shelf.

Frequent overstressing of fiber optic cable causes progressive degeneration that leads to failure.

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If you suspect damage to a fiber optic cable, either due to mishandling or an abnormally high error rate observed in one direction, reverse the cable pairs. If the high error rate appears in the other direction, replace the cable.

CAUTION
Risk of equipment damage
Do not crush fiber optic cable. If fiber optic cable is in the same tray or duct with large, heavy electrical cables, it can be damaged by the weight of the electrical cable.

Fiber optic connector care

Before connecting them to transmission equipment, test equipment, patch panels, or other connectors, ensure fiber optic connectors are clean. The performance of an optical fiber connector depends on how clean the connector and coupling are at the time of connection.

A damaged or dirty connector can damage a connector with which it is mated. A connector must be absolutely clean before it is inserted into a transmitter or receiver.

Never clean an optical connector that is carrying light. Optical power can cause ignition of the cleaning material when it contacts the end of the optical connector, destroying the connector. Typical cleaning materials, for example, tissues saturated with alcohol, combust almost instantaneously when exposed to optical power levels of +15 dBm or higher.

Visually inspect the connector to determine cleanliness and to determine if it needs replacing. Any connector that has a scratch across the core, or a scratch that appears to end in the core, must be replaced.

The proper connector cleaning method depends on the connector contaminants:

- Cleanliness is best judged by visual inspection with a fiber microscope. First inspect the connector, then clean as required.

  WARNING
  Risk of eye injury
  When inspecting a connector, ensure that light sources are off. The light source used in fiber optic cables can damage your eyes.

- If you suspect only the possibility of dust particles (for example, which can occur when a connector is left uncapped in a clean environment), use high-quality canned air or a reel ceaner (for example, a Cletop) to

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clean the connector. A reel cleaner is a good choice for making sure that no dust contaminates the connector.

- If the connector is visibly dirty or suspected to be contaminated by chemicals (for example, matching gel), use high-quality alcohol and canned air to clean the connector (see the following procedure). This is the most thorough cleaning method. In some cases, a reel cleaner may suffice.

Always keep in mind that the more surface manipulation applied to the connector, the more likely the connector is to become damaged.

When you insert a connector ferrule into a connector or adapter, ensure that the ferrule tip does not touch the outside of the mating connector or adapter. This can produce scratches and dirt deposits on the connector.

To help prevent them from collecting dust, ensure connectors are covered when not in use. To avoid the transfer of oil or other contaminants from your fingers to the end face of the ferrule, handle connectors with care. Do not touch the connector end face.

Cleaning single connectors

Clean connectors so that the optical signal is minimally attenuated by the connector.

This procedure is appropriate when more than dust contamination is suspected.

Prerequisites

- lens-grade, lint-free tissue (for example, Kimwipes)
- optical-grade isopropyl alcohol (IPA) (98% or more pure)
- high-quality canned compressed air with extension tube

  Compressed air must be free of dust, water and oil, or filmy deposits or scratches on the surface of the connector can result.
- fiber optic microscope for inspecting connectors

WARNING
Risk of eye injury
When inspecting a connector, ensure that light sources are off. The light source used in fiber optic cables can damage your eyes.

To avoid getting debris in your eyes, wear safety glasses when working with the canned air duster.

To avoid eye irritation on contact, wear safety glasses when working with isopropyl alcohol.

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Procedure steps

Step	Action
1	Remove dust or debris by applying canned air to the cylindrical and end-face surfaces of the connector.
2	Gently wipe the cylindrical and end-face surfaces with a tissue dampened with optical-grade isopropyl alcohol.
3	Gently wipe the cylindrical and end-face surfaces with a dry tissue.

ATTENTION
Do not let the IPA evaporate; wipe it dry immediately. Alcohols can leave a residue that is difficult to remove.

4	Dry the connector surfaces by applying canned air.
5	Inspect the connector to ensure it is clean and undamaged. To prevent contamination, do not touch the connector surfaces after cleaning; and cover connectors with dust caps if you are not going to use them right away.

--End--

Cleaning duplex connectors

Clean connectors so that the optical signal is minimally attenuated by the connector.

This procedure is appropriate when more than dust contamination is suspected.

Prerequisites

- lens-grade, lint-free tissue (for example, Kimwipes)
- optical-grade isopropyl alcohol (IPA) (98% or more pure)
- high-quality canned compressed air with extension tube

  Compressed air must be free of dust, water and oil, or filmy deposits or scratches on the surface of the connector can result.
- fiber optic microscope for inspecting connectors

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WARNING

Risk of eye injury

When inspecting a connector, ensure that light sources are off. The light source used in fiber optic cables can damage your eyes.

To avoid getting debris in your eyes, wear safety glasses when working with the canned air duster.

To avoid eye irritation on contact, wear safety glasses when working with isopropyl alcohol.

Procedure steps

Step	Action
1	To remove or retract the shroud, do one of the following. • On removable shroud connectors, hold the shroud on the top and bottom at the letter designation, apply medium pressure, and pull it free from the connector body. Do not discard the shroud. • On retractable shroud connectors, hold the shroud in its retracted position.
2	Remove dust or debris by applying canned air to the cylindrical and end-face surfaces of the connector.
3	Gently wipe the cylindrical and end-face surfaces of both ferrules using a tissue saturated with optical-grade isopropyl alcohol.
4	Gently wipe the cylindrical and end-face surfaces with a dry tissue.
	ATTENTION Do not let the IPA evaporate; wipe it dry immediately. Alcohols can leave a residue that is difficult to remove.
5	Blow dry the connector surfaces with canned air.
6	Inspect the connector to ensure it is clean and undamaged.
7	Using care to not touch the clean ferrules, gently push the shroud back onto the connector until it seats and locks in place.

--End--

Cleaning receptacles

Clean connector receptacles or ports so that the optical signal is minimally attenuated by the connection.

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Prerequisites

- optical-grade isopropyl alcohol (IPA) (98% or more pure)
- cleaning swabs (also called cleaning sticks or wands)
- high-quality canned compressed air with extension tube

  Compressed air must be free of dust, water and oil, or filmy deposits or scratches on the surface of the connector can result.

CAUTION
Risk of equipment damage
To avoid contamination, optical ports should only be cleaned when there is evidence of contamination or reduced performance, or during their initial installation.

To prevent oil contamination of connectors, use only high-quality canned compressed air.

Do not allow the air extension tube to touch the bottom of the optical port.

Procedure steps

Step	Action
1	Remove dust or debris by blowing canned air into the optical port of the device using the canned air extension tube.
2	Clean the optical port by inserting a wand moistened with alcohol into the receptacle and rotating it. Each cleaning wand should only be used to clean one optical port.
3	Dry the optical port by inserting a dry wand into the receptacle and rotating it.

ATTENTION
Do not let the IPA evaporate; wipe it dry immediately. Alcohols can leave a residue that is difficult to remove.

4	Remove any lint by blowing compressed air into the optical port.
5	Reconnect the optical connector and check for proper function. If you are not reinstalling the connector, be sure to use a protective cap. If problems persist, ensure that the connector or receptacle are not damaged.

--End--

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Product safety warnings and information

The products described in this guide meet requirements of:

IEC 60950 3rd edition
CSA 22.2 No. 60950 3rd edition
UL 60950 3rd edition
EN60950 3rd edition
EN60825-1, +A11, +A2

ESD and installation caution messages

This section provides electrostatic discharge (ESD) and installation caution messages.

CAUTION
Risk of equipment damage
To prevent damage from electrostatic discharge, always wear an antistatic wrist strap connected to an ESD jack.

CAUTION
ATTENTION
Risque d'endommagement de l'équipement

Pour prévenir tout dommage dû à une décharge électrostatique, vous devez toujours porter un un bracelet antistatique connecté à une prise ESD.

CAUTION
ACHTUNG
Risiko eines Geräteschadens

Risiko eines Geräteschadens Um Schäden durch elektrostatische Entladung zu verhindern, tragen Sie bei der Instandhaltung dieses Produkts immer ein antistatisches Band am Handgelenk, welches mit einer ESD-Buchse verbunden ist.

CAUTION
PRECAUCIÓN
Riesgo de daño del equipo

Para prevenir el daño producido por una descarga electrostática, use siempre una pulsera antiestática conectada a un enchufe ESD.

CAUTION
CUIDADO
Risco de danos ao equipamento

Para evitar danos com descarga eletrostática, sempre use uma pulseira antiestática que esteja conectada a uma tomada ESD.

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CAUTION
ATTENZIONE
Rischio di danni all'apparecchiatura

Per evitare danni derivanti da scariche elettrostatiche, indossare sempre un polsino antistatico collegato a una presa ESD.

CAUTION
Risk of equipment damage
Only trained personnel can install this product.

CAUTION
ATTENTION
Risque d'endommagement de l'équipement

L'installation doit être effectuée exclusivement par un personnel qualifié.

CAUTION
ACHTUNG
Risiko eines Geräteschadens

Nur geschultes Personal kann dieses Produkt installieren.

CAUTION
PRECAUCIÓN
Riesgo de daño del equipo

Sólo el personal capacitado puede instalar este producto.

CAUTION
CUIDADO
Risco de danos ao equipamento

Somente pessoal treinado pode instalar este produto.

CAUTION
ATTENZIONE
Rischio di danni all'apparecchiatura

Questo prodotto può essere installato solo da personale esperto.

Laser safety warnings

This section provides laser safety warnings.

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WARNING
Risk of eye injury by laser
Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables are connected to a light source.

WARNING
AVERTISSEMENT
Risques de blessure oculaire par lumière laser L'équipement de fibres optiques peut émettre une lumière laser ou infrarouge nuisible à vos yeux. Ne regardez jamais en direction de fibres optiques ou d'un port connecteur. Supposez toujours que les câbles de fibres optiques sont connectés à une source de lumière.

WARNING
WARNUNG
Risiko einer Augenverletzung durch Laser Glasfasergeräte können Laserstrahlen oder ultraviolettes Licht aussenden, das Ihre Augen verletzen kann. Schauen Sie nie direkt in einen Glasfaserleiter oder Verbindungsanschluss. Gehen Sie immer davon aus, dass Glasfaserkabel mit einer Lichtquelle verbunden sind.

WARNING
ADVERTENCIA
Riesgo de lesión en los ojos por láser El equipo de fibra óptica puede emitir una luz láser o infrarroja que dañe sus ojos. Nunca mire un puerto de fibra óptica o conector. Siempre asuma que los cables de fibra óptica están conectados a una fuente de luz.

WARNING
AVISO
O laser pode causar ferimentos no olho O equipamento de fibra ótica pode emitir laser ou luz infravermelha que pode causar danos a sua vista. Nunca olhe para dentro da fibra ótica ou da porta do conector. Tenha sempre em mente que os cabos de fibra ótica estão ligados a uma fonte de luz.

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WARNING
AVVISO
Rischio di ustioni agli occhi dovute al laser Le apparecchiature con fibre ottiche possono emettere raggi laser o infrarossi in grado di provocare ferite agli occhi. Non guardare mai all'interno di una porta di connessione o una fibra ottica. Tenere sempre presente che i cavi a fibra ottica sono collegati a una sorgente luminosa.

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Small form factor pluggable transceivers

This section describes how to select and install small form factor pluggable (SFP) transceivers.

Use an SFP to interface a device motherboard to a fiber optic or unshielded twisted pair network cable. The SFPs described in this section provide Ethernet at 1 gigabit per second (Gbit/s).

Navigation

- "Selecting an SFP" (page 21)
- "Installing an SFP" (page 24)
- "Removing an SFP" (page 27)
- "SFP specifications" (page 35)

Selecting an SFP

Use an SFP transceiver to interface a device motherboard to a fiber optic or unshielded twisted pair network cable. Select the appropriate transceiver to provide the required reach.

Procedure steps

Step	Action
1	Determine the required reach. Depending on the product, SFPs are available for cable distances of up to 100 meters (m), 550 m, 10 kilometers (km), 40 km, 70 km, and 120 km.
2	Determine the required media and connector type. Fiber optic cable is required for any reach over 100 m.

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Possible media include CAT5, single mode fiber, and multimode fiber. Possible connectors include LC (Lucent connector), MT-RJ, and RJ-45.

3 If the media is optical fiber, determine any wavelength restrictions or requirements.

To expand available bandwidth on a common optical fiber, use CWDM SFPs.

4 Determine if digital diagnostic monitoring (DDM) is required.

Not all SFPs or products support DDM.

5 Use the following job aids to determine the appropriate SFP for your application.

--End--

Job aid: SFPs and common applications

The following table describes the reach provided by various SFPs. This table is informational only—not all Nortel Ethernet switching and routing products support all the SFPs listed here.

Table 1
SFPs and common applications

SFP model	Common application
T1 Fast Ethernet to T1 Remote Bridge	Provides 1.544 Mbit/s connectivity with up to 2874 m reach over 22 AWG cable. The distance may be reduced when common 24 AWG UTP CAT5/5E cable is used. Applications include connecting remote LANs and providing transparent LAN services over leased lines.
100BASE-FX	Provides 100 Mbit/s LAN services with up to 2 km reach.
1000BASE-T	Lowest-cost Gigabit Ethernet solution. Up to 100 m reach over Category 5 (CAT5) unshielded twisted pair (UTP).
1000BASE-SX	Well-suited for campus local area networks (LAN) and intrabuilding links. Up to 275 or 550 m reach (fiber-dependent) over a fiber pair.
1000BASE-LX	Up to 10 km reach over a single mode fiber (SMF) pair. Up to 550 m reach over a multimode fiber (MMF) pair.
1000BASE-XD	Up to 40 km reach over a single mode fiber pair.
1000BASE-ZX	Up to 70 km reach over a single mode fiber pair.
1000BASE-BX	Up to 10 km reach. Bidirectional over one single mode fiber.

Job aid: SFP models without DDI support

SFPs are hot-swappable input/output enhancement components designed for use with Nortel products to allow Gigabit Ethernet ports to link with other Gigabit Ethernet ports over various media types.

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The SFPs described in this section do not have Digital Diagnostic Interface capability, and are RoHS -E5 compliant.

CWDM SFPS are also supported. CWDM technology consolidates multiple optical channels on a common optical fiber. CWDM uses multiple wavelengths to expand available bandwidth.

CWDM SFPs are designed to support high speed data communications for Metropolitan Area Networks (MANs). The system uses a grid of eight CWDM optical wavelengths in both ring and point-to-point configurations. All components are color-coded by wavelength.

ATTENTION
The attainable cable length can vary depending on the quality of the fiber optic cable used.

Table 2
SFP models without DDI support

Model and connector	Product number	Description
1000BASE-SX (LC)	AA1419013-E5	850 (nm), up to 275 or 550 m **NOTE:** This product is not supported on the Ethernet Routing Switch 4500 as of December 31, 2008. Use the newer version of this product after December 31, 2008 (AA1419048-E6).
1000BASE-SX (MT-RJ)	AA1419014-E5	850 nm, up to 275 or 550 m
1000BASE-LX (LC)	AA1419015-E5	1310 nm, up to 10 km **NOTE:** This product is not supported on the Ethernet Routing Switch 4500 as of December 31, 2008. Use the newer version of this product after December 31, 2008 (AA1419049-E6).
1000BASE-XD CWDM (LC)	AA1419025-E5 to AA1419032-E5	1470 nm to 1610 nm, up to 40 km
1000BASE-ZX CWDM (LC)	AA1419033-E5 to AA1419040-E5	1470 nm to 1610 nm, up to 70 km

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Model and connector	Product number	Description
100BASE-FX (LC)	AA1419074-E6	1310 nanometers (nm), up to 2 km Supported by the 4526FX, 4526T, 4526T-PWR, 4550T, 4550T-PWR and 4524GT
T1 (RJ-48C)	AA1419075-E6	1.544 Mbit/s Fast Ethernet to T1 remote bridge. Supported by the 4526FX, 4526T, 4526T-PWR, 4550T, 4550T-PWR and 4524GT

For specifications for these SFPs, see "SFP specifications" (page 35).

Job aid: SFP models with DDI support

Any Digital Diagnostic Indicating (DDI) SFP can be used in any Ethernet Routing Switch 4500 that supports SFPs beginning with Release 5.2. The optical functions of the SFP are supported. Access to the DDI information will be provided in a future release.

The following table lists and describes the Nortel SFP models with DDI capability.

Table 3
SFP models with DDI capability

Model	Product number	Description
1000BASE-T (RJ-45)	AA1419043-E6	CAT5 UTP, up to 100 m. Note that because the 1000BASE-T device is all electrical, there is no need for DDI support.
1000BASE-SX	AA1419048-E6	850 nm, up to 275 or 550 m
1000BASE-LX	AA1419049-E6	1310 nm, up to 10 km
1000BASE-BX (LC type)	AA1419069-E6, AA1419070-E6	Bidirectional 1310 nm and 1490 nm, up to 10 km

For specifications for these SFPs, see "SFP specifications" (page 35).

Installing an SFP

Install an SFP to provide an interface between the switch and the network cable.

Installing an SFP takes about three minutes.

For translations of the following messages, see "Product safety warnings and information" (page 16).

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WARNING
Risk of eye injury by laser
Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables are connected to a light source.

CAUTION
Risk of equipment damage
To prevent damage from electrostatic discharge, always wear an antistatic wrist strap connected to an ESD jack.

CAUTION
Risk of equipment damage
Only trained personnel can install this product.

Prerequisites

- Verify that the SFP is the correct model for your network configuration.
- Before installing the optical connector, ensure it is clean.

Procedure steps

Step	Action
1	Remove the SFP from its protective packaging.
2	Grasp the SFP between your thumb and forefinger.
3	As shown in the following figure, insert the device into the slot on the module.

CAUTION
Risk of equipment damage
SFPs are keyed to prevent incorrect insertion. If the SFP resists pressure, do not force it; turn it over, and reinsert it.

Apply a light pressure to the device until it clicks and locks into position.

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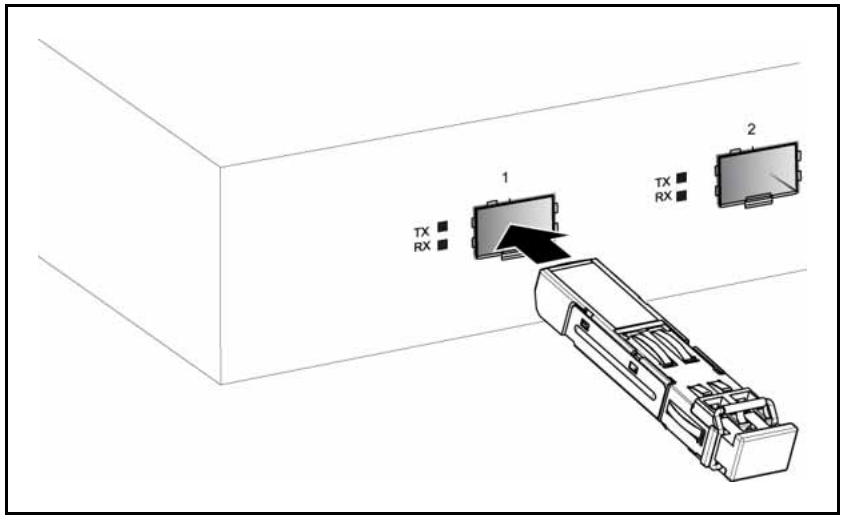


4 Remove the dust cover from the optical bore and insert the fiber optic connector.

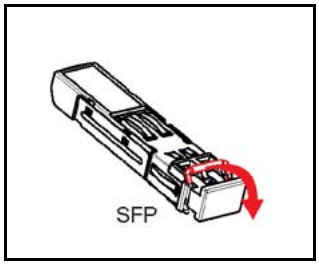
--End--

Job aid: locking and extractor mechanisms

Depending on the transceiver manufacturer, your SFP transceiver can have various types of locking/extractor mechanisms.

The following figures shows a typical mechanisms used on SFP transceivers; other locking/extractor mechanisms exist, although they are not shown here. In the figure Figure 1 "SFP with bail lock and extraction mechanism" (page 26), the SFP still has the bore plug installed. Pull the bail to release the device.

Figure 1
SFP with bail lock and extraction mechanism



The following figure shows the 1000BASE-SX MT-RJ SFP. Push the tab to release the device.

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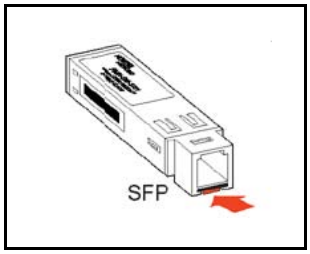
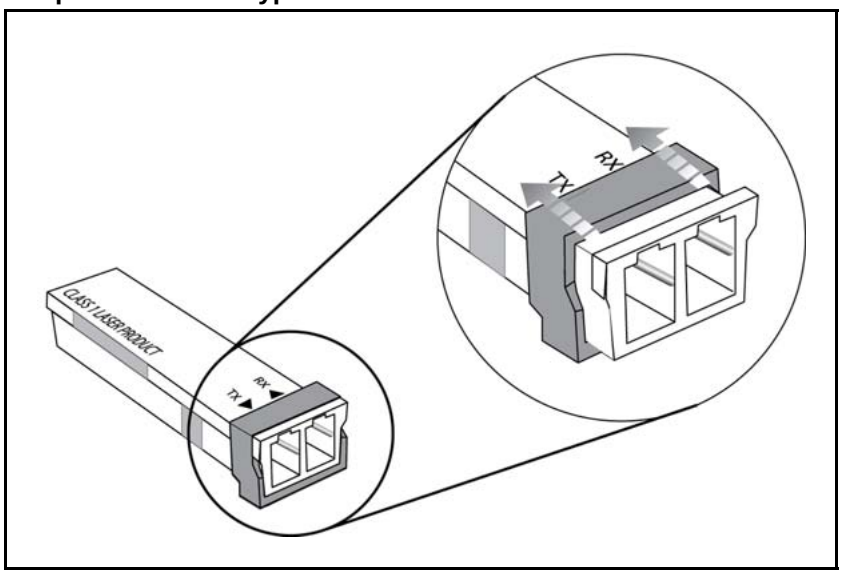
Figure 2
1000BASE-SX MT-RJ SFP extraction mechanism



The following figure shows the wrap-around latch-type extraction mechanism. To remove the device, push the collar towards the module.

Figure 3
Wrap-around latch-type extraction mechanism



Removing an SFP

Remove an SFP to replace it or to commission it elsewhere.

For translations of the following messages, see “Product safety warnings and information” (page 16).

WARNING
Risk of eye injury by laser
Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables are connected to a light source.

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CAUTION
Risk of equipment damage
To prevent damage from electrostatic discharge, always wear an antistatic wrist strap connected to an ESD jack.

Procedure steps

Step	Action
1	Disconnect the network fiber cable from the SFP connector.
2	Affix dust covers over the fiber optic bore and connector.
3	Depending on your SFP model, to release the SFP, press the locking/extractor mechanism. Your SFP locking/extractor mechanism can be different than the models shown.
4	Slide the SFP out of the module SFP slot. If the SFP does not slide easily from the module slot, use a gentle side-to-side rocking motion while firmly pulling the SFP from the slot.
5	Store the SFP in a safe place until needed.

ATTENTION
If you discard the SFP, be sure to dispose of it according to all national laws and regulations.

--End--

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10 Gigabit small form factor pluggable transceivers

This section describes how to install and remove 10 Gigabit Small Form Factor Pluggable (XFP) transceivers, and lists some technical specifications for the supported XFP models.

ATTENTION
Nortel recommends that you only use Nortel-qualified XFPs. If you do choose to use other vendor XFPs, be aware that Nortel does not support the use of other XFPs.

Navigation

- "Selecting an XFP" (page 29)
- "Installing an XFP" (page 30)
- "Removing an XFP" (page 32)
- "XFP specifications" (page 47)

Selecting an XFP

Use an XFP transceiver to interface a device motherboard to a fiber optic cable. Select the appropriate transceiver to provide the required reach.

Procedure steps

Step	Action
1	Determine the required reach. Depending on the product, XFPs are available for cable distances of up to 300 meters (m), 10 kilometers (km), 40 km, and 80 km.
2	Determine any wavelength restrictions or requirements.

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3 Use the following job aids to determine the appropriate XFP for your application.

--End--

Job aid: XFP models

XFPs are hot-swappable input/output enhancement components designed for use with Nortel products to allow 10 Gigabit Ethernet ports to link with other 10 Gigabit Ethernet ports.

All Nortel XFPs use Lucent connectors (LC) to provide precision keying and low interface losses.

The following table lists and describes the Nortel XFP models. For specifications for these XFPs, see "XFP specifications" (page 47). Not all products support all XFPs.

Table 4
XFP models for the Ethernet Routing Switch 4500 Series

Model number	Product number	Description
10GBASE-SR	AA1403005-E5	850 nanometers (nm). The range is up to: • 22 m using 62.5 micrometer (µm), 160 megaHertz times km (MHz-km) MMF • 33 m using 62.5 µm, 200 MHz-km MMF • 66 m using 62.5 µm, 500 MHz-km MMF • 82 m using 50 µm, 500 MHz-km MMF • 300 m using 50 µm, 2000 MHz-km MMF
10GBASE-ZR/ZW	AA1403006-E5	1550 nm SMF. The range is up to 80 km.
10GBASE-LR/LW	AA1403001-E5	1310 nm SMF. The range is up to 10 km.
10GBASE-LRM	AA1403007-E6	1310 nm. Up to 220 m reach over Fiber Distributed Data Interface (FDDI)-grade 62.5 µm multimode fiber. Suited for campus LANs.

Installing an XFP

Install an XFP to provide a 10 Gigabit Ethernet interface between the switch and other network devices.

Installing an XFP takes about three minutes.

For translations of the following messages, see "Product safety warnings and information" (page 16).

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WARNING
Risk of eye injury by laser
Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables are connected to a light source.

CAUTION
Risk of equipment damage
To prevent damage from electrostatic discharge, always wear an antistatic wrist strap connected to an ESD jack.

CAUTION
Risk of equipment damage
Only trained personnel can install this product.

Prerequisites

- Verify that the XFP is the correct model for your network configuration.
- Before installing the optical connector, ensure it is clean.

Procedure steps

CAUTION
Risk of equipment damage
XFPs are keyed to prevent incorrect insertion. If the XFP resists pressure, do not force it; turn it over, and reinsert it.

Procedure steps

Step	Action
1	Remove the XFP from its protective packaging.
2	Grasp the XFP between your thumb and forefinger.
3	Insert the XFP into the XFP slot on the module. Apply a light pressure to the XFP until the device clicks and locks into position in the module.

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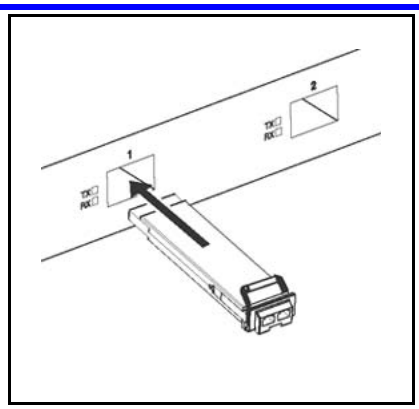


4 Remove the dust cover from the XFP optical bores and insert the fiber optic cable.

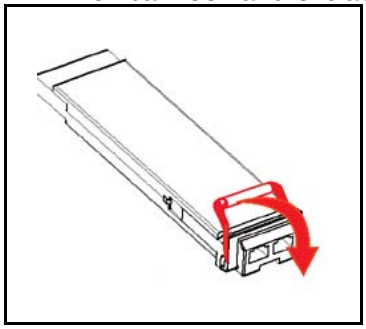
--End--

Job aid: locking and extractor mechanisms

Depending on the transceiver manufacturer, your XFP transceiver can have various types of locking/extractor mechanisms.

The following figure shows a typical bail-type mechanism used on XFP transceivers. Pull the bail down to release the device.

Figure 4
XFP with bail lock and extraction mechanism



Removing an XFP

Remove an XFP to replace it or to commission it elsewhere.

For translations of the following messages, see “Product safety warnings and information” (page 16).

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WARNING
Risk of eye injury by laser
Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables are connected to a light source.

CAUTION
Risk of equipment damage
To prevent damage from electrostatic discharge, always wear an antistatic wrist strap connected to an ESD jack.

Procedure steps

Step	Action
1	Disconnect the network fiber cable from the XFP connector.
2	Affix a dust cover over the optical connector.
3	Pull the bail mechanism on the XFP to release the XFP.
4	Slide the XFP out of the module XFP slot. If the XFP does not slide easily from the module slot, use a gentle side-to-side rocking motion while firmly pulling the XFP from the slot.
5	Replace the port dust cover or EMI plug in the module.
6	Store the XFP in a safe place until needed.

ATTENTION
If you discard the XFP, be sure to dispose of it according to all national laws and regulations.

--End--

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SFP specifications

This section provides technical specifications for the supported small form factor pluggable (SFP) models. Use this information to aid in proper network design.

The specifications given in this section meet or exceed those specified in the applicable IEEE standards, where they exist.

In these specifications, unless otherwise noted, *receiver sensitivity* is defined as the minimum average input optical power for which the receiver is guaranteed to meet the bit error rate (BER) of 10^{-12}.

Navigation

- "SFP labels" (page 35)
- "General SFP specifications" (page 36)
- "T1 SFP specifications" (page 36)
- "1000BASE-T SFP specifications" (page 39)
- "1000BASE-SX (LC) SFP specifications" (page 40)
- "1000BASE-SX (MT-RJ) SFP specifications" (page 41)
- "1000BASE-LX SFP specifications" (page 41)
- "1000BASE-XD CWDM SFP specifications" (page 42)
- "1000BASE-ZX CWDM SFP specifications" (page 43)
- "1000BASE-SX DDI SFP specifications" (page 43)
- "1000BASE-LX DDI SFP specifications" (page 44)
- "1000BASE-BX DDI SFP specifications" (page 44)

SFP labels

The Nortel label on a typical SFP contains a Nortel serial number, a bar code, a manufacturer's code, an interface type, and a part number.

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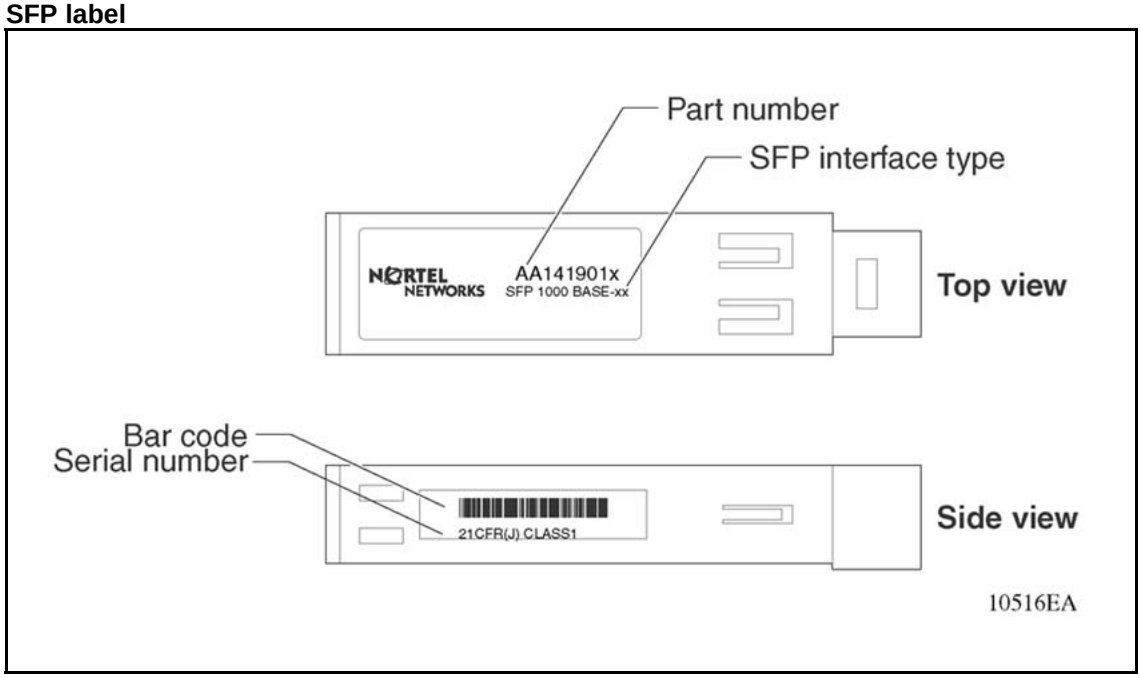
Figure 5
SFP label



General SFP specifications

The following table describes general SFP specifications.

Table 5
General SFP specifications

Parameter	Description
Dimensions (H x W x D)	13.4 x 8.50 x 56.4 millimeters (mm) 0.53 x 0.33 x 2.22 inches (in.) unless otherwise stated
Operating temperature	-5 to 85C for RoHS -E6 models 0 to 60C for RoHS -E5 models
Storage temperature	-40 to 85C
Maximum supply current	300 mA unless otherwise stated
Maximum power consumption	1.0 W unless otherwise stated

T1 SFP specifications

The T1 SFP provides full-duplex Fast Ethernet to T1 connectivity. The part number for this model is AA1419075-E6.

This device can be used with the Ethernet Routing Switch 4526FX, 4526T, 4526T-PWR, 4550T, 4550T-PWR, and 4524GT.

The following table describes the T1 SFP specifications.

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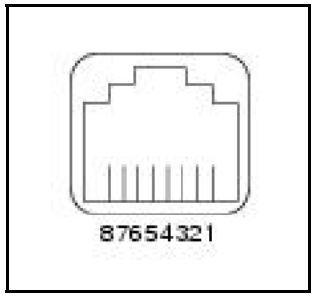
Table 6
Fast Ethernet to T1 remote bridge specifications

Parameter	Specifications
Maximum power consumption	1 W
Dimensions	Height: 13.8 mm (0.54 in) Width: 15.8 mm (0.62 in) Depth: 75.9 mm (2.99 in)
Standards	Compliant with G.703, G.775, G.823, T1.403, IEEE 802.3
Connectors	RJ-48C
Cabling	CAT5 with RJ-48C pin connection
Distance	Up to 2874 m over 22 AWG cable. The distance may be reduced when common 24 AWG UTP CAT5/5E cable is used.
Line code	Binary 8 Zero Substitution (B8ZS) or Alternate Mark Inversion (AMI)

The T1 SFP uses an RJ-48C connector (see the following figure), which is similar to an RJ-45 connection, but with different pinouts.



The following table describes the RJ-48C pinouts.

Table 7
RJ-48C pinouts

Pin	Description
1	Receive ring
2	Receive tip
3	Receive shield
4	Transmit ring
5	Transmit tip
6	Transmit shield
7	Not used
8	Not used

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The T1 equipment at the far end of the T1 connection must also use an RJ-48C jack. After the pinout of the RJ-48C jack at the far end is determined, determine if a straight-through or crossover cable is required. An off-the-shelf straight-through cable can be used to directly connect the T1 SFP module and the far-end T1 equipment if the far end has the pinout shown in the following table.

Table 8
RJ-48C pinouts (opposite Tx and Rx connection)

Pin	Description
1	Transmit (Tx) ring
2	Transmit tip
3	Transmit shield
4	Receive (Rx) ring
5	Receive tip
6	Receive shield
7	Not used
8	Not used

If the far end connection does not match the connections shown in this table (Table 8 "RJ-48C pinouts (opposite Tx and Rx connection)" (page 38)), then a crossover cable must be used. The crossover connections are as shown in the following table.

Table 9
RJ-48C crossover cable connections

Terminal A			Terminal B	
Pin	**Description**		**Pin**	**Description**
1	Receive ring		1	Transmit ring
2	Receive tip		2	Transmit tip
3	Receive shield		3	Transmit shield
4	Transmit ring		4	Receive ring
5	Transmit tip		5	Receive tip
6	Transmit shield		6	Receive shield
7	Not used		7	Not used
8	Not used		8	Not used

You can use a short crossover cable with a straight-through cable adapter to connect to a straight-through cable. Do this to convert a straight-through cable to a crossover cable.

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T1 SFP—default settings

The Ethernet Routing Switch 4500 Series switches automatically configure the following T1 SFP parameters after the system powers up:

- Transmit Line Build Out (TLBO): set according to cable length.
- Framed or Unframed: Insert framing word into the frame (1 bit per T1 frame) or do not insert framing word into the frame.
- Line code: Binary 8 Zero Substitution (B8ZS) or Alternate Mark Inversion (AMI).
- Clock: Use Rx clock or internal clock for Tx clock (Nortel recommends internal clock for Tx clock).
- Framing: D4 or Extended Super Frame (ESF), depends on the framing word required by the T1 equipment at the far end.

Table 10
T1 SFP—default parameters

Parameter	Default setting
TLBO	0 (0 ft–133 ft)
Framed or unframed	1 (framed)
Line code	0 (B8ZS)
Tx clock source	1 (Tx clock)
Framing	1 (ESF)
Rx sensitivity	1 (limited long haul)
Yellow alarm	0 (normal operation)
Fault propagation	0 (normal operation)
Tx disabled behavior	2 (Alarm Indications Signal—AIS)
Transmit AIS	0 (normal operation)

ATTENTION
The T1 SFP module must be configured to match the parameters of the T1 equipment at the far end. If you must change the parameters, contact Nortel Technical Support.

1000BASE-T SFP specifications

The 1000BASE-T SFP provides Gigabit Ethernet connectivity using a single eight-pin RJ-45 connector. The 1000BASE-T SFP only operates at 1 gigabit per second (1 Gbit/s) and does not support 100BASE-T or 10BASE-T interfaces. The part number for this model is AA1419043-E6.

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ATTENTION
You must disable Auto-Negotiation before operating the 1000BASE-T SFP. By default, SFPs inserted into certain product-specific modules are set for Auto-Negotiation = True.

The maximum current requirement of the SFP is 375 milliamperes (mA) at 5 volts (V).

The following table describes the 1000BASE-T SFP specifications.

Table 11
IEEE 802.3z 1000BASE-T SFP specifications

Parameter	Specifications
Standards	IEEE 802.3z, IEEE 802.3ab
Connectors	RJ-45
Cabling	CAT5E or better UTP
Distance	Up to 100 m

1000BASE-SX (LC) SFP specifications

The 1000BASE-SX SFP provides 1000BASE-SX Gigabit Ethernet connectivity at 850 nm using multimode optical fiber. This SFP supports full-duplex operation only. The part number for this model is AA1419013-E5.

The following table describes standards, connectors, cabling, and distance for the 1000BASE-SX SFP.

Table 12
IEEE 802.3z 1000BASE-SX (LC) SFP specifications

Parameter	Specifications
Connectors	Duplex LC
Cabling	• 62.5 µm MMF optic cable • 50 µm MMF optic cable
Distance	• up to 275 m using 62.5 µm MMF optic cable • up to 550 m using 50 µm MMF optic cable
Wavelength	850 nanometers (nm)
Link optical power budget	7.0 deciBels (dB)
Transmitter characteristics	
Launch power	-10 to -4.0 deciBels referenced to 1 milliwatt (dBm)
Receiver characteristics	

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Parameter	Specifications
Receiver sensitivity	-17 dBm
Maximum input power	0 dBm

1000BASE-SX (MT-RJ) SFP specifications

The 1000BASE-SX (MT-RJ type) SFP provides Gigabit Ethernet connectivity using MT-RJ multimode fiber connectors. The following table describes standards, connectors, cabling, and distance for the 1000BASE-SX (MT-RJ type) SFP. The part number for this model is AA1419014-E5.

Table 13
IEEE 802.3z 1000BASE-SX (MT-RJ) SFP specifications

Parameter	Specifications
Connectors	Duplex MT-RJ
Cabling	• 62.5 µm MMF optic cable • 50 µm MMF optic cable
Distance	• up to 275 m using 62.5 µm MMF optic cable • up to 550 m using 50 µm MMF optic cable
Wavelength	850 nm
Link optical power budget	7.0 dB
Transmitter characteristics	
Launch power	-10 to -4.0 dBm
Receiver characteristics	
Receiver sensitivity	-17 dBm
Maximum input power	0 dBm

1000BASE-LX SFP specifications

The 1000BASE-LX SFP provides 1000BASE-LX Gigabit Ethernet connectivity at 1310 nanometers (nm) using single mode or multimode optical fiber. The 1000BASE-LX SFP supports full-duplex operation only. The part number for this model is AA1419015-E5.

The following table describes standards, connectors, cabling, and distance for the 1000BASE-LX SFP.

Table 14
IEEE 802.3z 1000BASE-LX SFP specifications

Parameter	Specifications
Connectors	Duplex LC

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Parameter	Specifications
Cabling	• 50 micrometer (µm) multimode fiber (MMF) • 62.5 µm multimode fiber • 9 µm single mode fiber (SMF)
Distance	• Up to 550 meters (m) using MMF • Up to 10 kilometers (km) using SMF
Wavelength	1310 nm
Link optical power budget	10.5 dB
Transmitter characteristics	
Launch power	-9.5 to -3.0 dBm
Receiver characteristics	
Receiver sensitivity	-20 dBm
Maximum input power	-3.0 dBm

1000BASE-XD CWDM SFP specifications

The 1000BASE-XD SFPs provides CWDM Gigabit Ethernet connectivity using single mode fiber. These SFPs support full-duplex operation only. The part numbers of the 40 km models range from AA1419025-E5 to AA1419032-E5.

ATTENTION
For the 40 km CWDM SFPs, a minimum attenuation of 4 dB must be present between the transmitter and receiver. To avoid receiver saturation, you must insert a minimum attenuation of 4 dB when you test the CWDM SFP in loopback mode, or use short runs of fiber with no intermediate CWDM OADM or CWDM OMUX.

Table 15
1000BASE-XD CWDM (40 km) SFP specifications

Parameter	Specifications
Connectors	Duplex LC
Cabling	SMF, 9 µm
Data rate	1.0 Gbit/s
Line rate (8B/10B code)	1.25 Gbit/s
Operating temperature range	0 to 60C
Link optical power budget	17 dB
Transmitter characteristics	
Launch power	-4.0 to 1.0 dBm
Receiver characteristics	

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Parameter	Specifications
Receiver sensitivity	-21 dBm
Maximum input power	-3.0 dBm

1000BASE-ZX CWDM SFP specifications

The 1000BASE-ZX SFPs provides CWDM Gigabit Ethernet connectivity using single mode fiber. These SFPs support full-duplex operation only. The part numbers of the 70 km models range from AA1419033-E5 to AA1419040-E5.

ATTENTION
For the 70 km CWDM SFPs, a minimum attenuation of 10 dB must be present between the transmitter and receiver.

Table 16
1000BASE-ZX CWDM (70 km) SFP specifications

Parameter	Specifications
Connectors	Duplex LC
Cabling	SMF, 9 µm
Data rate	1.0 Gbit/s
Line rate (8B/10B code)	1.25 Gbit/s
Operating temperature range	0 to 60C
Link optical power budget	20 dB
Transmitter characteristics	
Launch power	-3.0 to 2.0 dBm
Receiver characteristics	
Receiver sensitivity	-23 dBm
Maximum input power	-3.0 dBm

1000BASE-SX DDI SFP specifications

The following table describes the 1000BASE-SX DDI SFP, which has a reach of up to 550 m using 50 µm MMF, and of 275 m using 62.5 µm MMF. This SFP operates at 850 nm. The part number of this SFP is AA1419048-E6.

Table 17
1000BASE-SX SFP DDI (550 m) specifications

Parameter	Specifications
Maximum electrical power consumption	1 watt (W)
Connector	Duplex LC

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Parameter	Specifications
Cabling	MMF
Data rate	1.0 Gbit/s
Line rate (8B/10B code)	1.25 Gbit/s
Link optical power budget	7.5 dB
Transmitter characteristics	
Launch power	-9.5 to -4.0 dBm
Receiver characteristics	
Receiver sensitivity	-17 dBm
Maximum receiver power	0 dBm

1000BASE-LX DDI SFP specifications

This SFP can attain a reach of up to 10 km and operates at 1310 nm. The part number of this SFP is AA1419049-E6.

Table 18
1000BASE-LX DDI SFP specifications

Parameter	Specifications
Maximum electrical power consumption	1.0 watt (W)
Connectors	Duplex LC
Cabling	SMF, 9 µm
Data rate	1.0 Gbit/s
Line rate (8B/10B code)	1.25 Gbit/s
Link optical power budget	9.5 dB
Transmitter characteristics	
Launch power	-9.5 to -3.0 dBm
Receiver characteristics	
Receiver sensitivity	-19.0 dBm
Maximum receiver power	-3.0 dBm

1000BASE-BX DDI SFP specifications

The 1000BASE-BX bidirectional SFPs (part numbers AA1419069-E6 and AA1419070-E6) provide Gigabit Ethernet connectivity over a single fiber.

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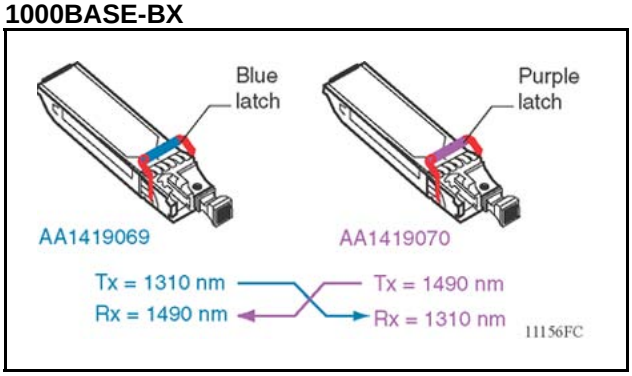
Figure 6
1000BASE-BX



As shown in the previous figure, the transmit (Tx) and receive (Rx) paths share the same fiber by using two different wavelengths. One model transmits at 1310 nm and receives at 1490 nm, while the mating model transmits at 1490 nm and receives at 1310 nm. You can only connect a mating pair.

You can use 1000BASE-BX SFPs to double the number of your fiber links. For example, if you have 20 installed fiber pairs with 20 conventional ports connected, you can use 1000BASE-BX SFPs to expand to 40 ports, using the same fiber.

The long wavelength optical transceivers used in these models provide variable distance ranges using single mode fiber optic cabling.

The following table describes standards, connectors, cabling, and distances for the 1000BASE-BX SFP.

Table 19
IEEE 802.3ah 1000BASE-BX10 SFP specifications

Parameter	Specifications
Connectors	Single-fiber LC
Data rate	1.0 Gbit/s
Line rate (8B/10B code)	1.25 Gbit/s
Distance	Up to 10 km
Wavelength	1310 nm and 1490 nm
Link optical power budget	11.0 dB
Maximum transmitter and dispersion power penalty	3.3 dB
Transmitter characteristics	
Maximum launch power	-3.0 dBm
Minimum launch power	-9.0 dBm

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Parameter	Specifications
Receiver characteristics	
Maximum receiver sensitivity	-19.5 dBm
Maximum input power (maximum average receive power)	-3.0 dBm

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XFP specifications

This section provides technical specifications for the supported 10 Gigabit SFP (XFP) models. Use these specifications to aid in network design.

The specifications provided here are a subset of the IEEE 802.3ae and 802.3aq specifications. For more details, see these standards documents. All Nortel XFPs meet or exceed these standards.

ATTENTION
Nortel recommends that you only use Nortel-qualified XFPs. If you do choose to use other vendor XFPs, be aware that Nortel does not support the use of other XFPs.

Navigation

- "XFP labels" (page 47)
- "General XFP specifications" (page 48)
- "10GBASE-SR XFP specifications" (page 48)
- "10GBASE-LRM XFP specifications" (page 50)
- "10GBASE-LR/LW XFP specifications" (page 52)
- "10GBASE-ZR/ZW XFP specifications" (page 53)

XFP labels

The Nortel label on a typical XFP contains a Nortel serial number, a bar code, a manufacturer's code, an interface type, and a part number.

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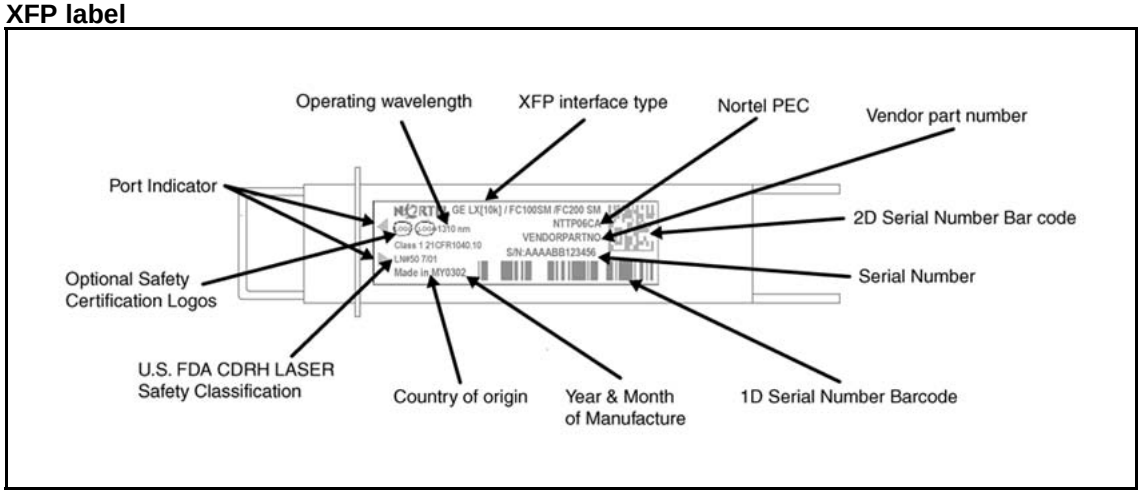
Figure 7
XFP label



General XFP specifications

The following table describes general XFP specifications.

Table 20
General XFP specifications

Parameter	Specifications
Dimensions (H x W x D)	0.49 x 0.72 x 2.79 inches (in.) 12.5 x 18.35 x 71.1 millimeters (mm)
Connectors	LC ultra physical contact (UPC)
Storage temperature	-40 to 85C
Operating temperature	0 to 70C

10GBASE-SR XFP specifications

The 10GBASE-SR SFP provides 10 GbE service at 850 nm.

The following table lists the specifications for the 10GBASE-SR XFP. The part number of this XFP is AA1403005-E5.

For more information about the 10GBASE-SR XFP, including test and measurement information, see the IEEE 802.3ae standard.

CAUTION
Risk of equipment damage
To prevent damage to the optical receiver, ensure that at least 1 dB of attenuation is present between the transmit and receive ports.

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Table 21
IEEE 802.3ae 10GBASE-SR XFP specifications

Parameter	Specifications
Data rate	10.0 Gbit/s
Line rate (64B/66B code)	10.3125 gigabits per second (Gbit/s) ± 100 parts per million (ppm)
Mean Time Between Failures (MTBF)	675 000 hours
Center wavelength range	840 to 860 nanometers (nm), nominal 850 nm
Distance	Using 62.5 µm MMF optic cable: • 160 MHz-km fiber: 2 to 26 m • 200 MHz-km fiber: 2 to 33 m Using 50 µm MMF optic cable: • 400 MHz-km fiber: 2 to 66 m • 500 MHz-km fiber: 2 to 82 m • 2000 MHz-km fiber: 2 to 300 m
Link optical power budget	7.3 dB
Maximum transmitter and dispersion penalty	3.9 dB at 300 m
Transmitter characteristics	
Root-mean-square spectral width	0.05 to 0.40 nm
Launch power	-7.3 to -1.0 deciBels referenced to 1 milliwatt (dBm)
Maximum average launch power of OFF transmitter	-30 dBm
Minimum extinction ratio	3.0 dB
Maximum relative intensity noise $_{12}$OMA	-128 dB per Hertz (dB/Hz)
Maximum optical return loss tolerance	-12 dB
Receiver characteristics	
Average receive power for BER 10^{-12}	-9.9 to -1.0 dBm
Maximum average receive power for damage	0 dBm
Maximum receiver sensitivity in OMA	-11.1 dBm
Maximum receiver reflectance	-12 dB
Stressed receiver sensitivity in OMA	-7.5 dBm
Receiver electrical 3 dB upper cutoff frequency	12.3 gigaHertz (GHz)

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The stressed sensitivity values are for system level BER measurements, which include the effects of CDR circuits. Nortel recommends that you allocate at least 0.4 dB additional margin if you make component level measurements without the effect of CDR circuits.

10GBASE-LRM XFP specifications

The 10GBASE-LRM XFP provides 10 GbE service at a wavelength of 1310 nm. This XFP can attain a reach of up to 220 m on 62.5 µm multimode fiber. This XFP provides built-in electronic dispersion compensation.

The following table lists the transmitter and receiver specifications for the 10GBASE-LRM XFP. These parameters are as specified by the IEEE 802.3aq-2006 standard. The part number of this XFP is AA1403007-E6.

In this table, note that the OMA, average launch power, and peak power specifications apply at TP2, after patch cord loss is accounted for.

Table 22
IEEE 802.3aq 10GBASE-LRM XFP specifications

Parameter	Specifications
Data rate	10.0 Gbit/s
Line rate (64B/66B code)	10.3125 Gbit/s ± 100 ppm
Center wavelength range	1260 to 1355 nm; 1310 nm nominal
Distance	Up to 220 m, see Table 23 "10GBASE-LRM channel insertion loss and range" (page 51)
Link optical power budget	1.7 to 1.9 dB, see Table 23 "10GBASE-LRM channel insertion loss and range" (page 51)
Maximum transmitter waveform and dispersion penalty (TWDP)	4.7 dB
Transmitter characteristics	
Average launch power	-6.5 to 0.5 dBm
Peak launch power	3 dBm
Root-mean-square spectral width	2.4 to 4 nm
Launch power in OMA	-4.5 to 1.5 dBm
Maximum average launch power of OFF transmitter	-30 dBm
Minimum extinction ratio	3.5 dB
Maximum relative intensity noise at OMA—$RIN_{12}OMA$	-128 dB/Hz
Optical return loss tolerance (minimum)	-20 dB

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Parameter	Specifications
Receiver characteristics	
Maximum receive average power for damage	1.5 dBm
Receiver reflectance (maximum)	-12 dB

For more information about the conditions used for the stressed receiver tests, and other information, see the IEEE 802.3aq standard.

The following table (from IEEE 802.3aq) describes the maximum channel insertion loss. The channel insertion loss includes both attenuation and connector loss (1.5 dB); therefore the maximum fiber attenuation is 0.2 to 0.4 dB.

Table 23
10GBASE-LRM channel insertion loss and range

Fiber type (core diameter and OFL bandwidth)	Range	Maximum channel insertion loss
62.5 µm (FDDI grade) • 160 MHz-km at 850 nm • 500 MHz-km at 1300 nm	Up to 220 m	1.9 dB
62.5 µm (ISO/IEC OM1) • 200 MHz-km at 850 nm • 500 MHz-km at 1300 nm	Up to 220 m	1.9 dB
50 µm (ISO/IEC OM2) • 500 MHz-km at 850 nm • 500 MHz-km at 1300 nm	Up to 220 m	1.9 dB
50 µm • 400 MHz-km at 850 nm • 400 MHz-km at 1300 nm	Up to 100 m	1.7 dB
50 µm (ISO/IEC OM3) • 1500 MHz-km at 850 nm (includes laser launch bandwidth) • 500 MHz-km at 1300 nm (includes laser launch bandwidth)	Up to 220 m	1.9 dB

In the table, FDDI denotes Fiber Distributed Data Interface, ISO denotes International Standards Organization, IEC denotes International Electrotechnical Commission, and OFL denotes Over Filled Launch.

The following table is also based on the 802.3aq standard and specifies the measurement conditions for each fiber type.

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Table 24
Launch conditions for each fiber type

Parameter	Minimum encircled flux	Notes
Optical launch for OM1 and FDDI-grade fiber	• 30% within 5 µm radius • 81% within 11 µm radius	Uses 62.5 µmmode conditioning patch cord
Optical launch for OM2 and 50 µm 400/400 fiber	• 30% within 5 µm radius • 81% within 11 µm radius	Uses 50 µmmode conditioning patch cord
Optical launch for OM3 and 50 µm fiber	• 30% within 5 µm radius • 81% within 11 µm radius	

10GBASE-LR/LW XFP specifications

The 10GBASE-LX XFP provides 10 GbE or OC-192 service at a nominal wavelength of 1310 nm. This XFP can attain link lengths of up to 10 km.

The following table lists the transmitter and receiver specifications for the 10GBASE-LR/LW XFP. The part number of this XFP is AA1403001-E5.

For more information about the 10GBASE-LX XFP, including test and measurement information, see the IEEE 802.3ae standard.

Table 25
IEEE 802.3ae 10GBASE-LR/LW XFP specifications

Parameter	Specifications
MTBF	675 000 hours
Center wavelength range	1260 to 1355 nm; 1310 nm nominal
Distance	Up to 10 km
Link optical power budget	9.4 dB
Maximum transmitter and dispersion penalty	3.2 dB at 10 km
Transmitter characteristics	
Line rate (nominal)	10GBASE-LR 10.3125 Gbit/s ±100 ppm (10 GbE) 10GBASE-LW 9.95328 Gbit/s ±20 ppm (OC-192)
Average launch power	-8.2 to 0.5 dBm
Minimum side mode suppression ratio	30 dB
Minimum launch power in OMA minus transmission and dispersion penalty (TDP)	-6.2 dBm
Minimum optical modulation amplitude	-5.2 dBm

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Table 25
IEEE 802.3ae 10GBASE-LR/LW XFP specifications (cont'd.)

Parameter	Specifications
Maximum average launch power of OFF transmitter[c]	-30 dBm
Minimum extinction ratio	3.5 dB
$RIN_{12}OMA$ (maximum)	-128 dB/Hz
Maximum optical return loss tolerance	-12 dB
Maximum transmitter reflectance	-12 dB
Receiver characteristics	
Line rate (nominal)	10GBASE-LR 10.3125 Gbit/s ± 100 ppm (10 GbE) 10GBASE-LW 9.95328 Gbit/s ± 100 ppm (OC-192)
Average receive power for BER 10^{-12}	-14.4 dBm to 0.5 dBm
Maximum average receive power for damage	1.5 dBm
Maximum receiver sensitivity in OMA	-12.6 dBm
Maximum receiver reflectance	-12 dB
Stressed receiver sensitivity in OMA	-10.3 dBm
Receiver electrical 3 dB upper cutoff frequency	12.3 GHz

c Examples of an OFF transmitter are: no power supplied to the PDM, laser shutdown for safety conditions, activation of a PMD_global_transmit_disable or other optional transmitter shut down condition

10GBASE-ZR/ZW XFP specifications

The following table lists the transmit and receive specifications for the 10GBASE-ZR/ZW XFP. The reach is up to 80 km at a wavelength of 1550 nm. The part number of this XFP is AA1403006-E5.

For more information about the 10GBASE-ZX XFP, including test and measurement information and more specifications, see the IEEE 802.3ae standard.

CAUTION
Risk of BER increase
For proper XFP operation, ensure that at least 11 dB of attenuation is present between the transmit and receive ports.

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Table 26
10GBASE-ZR/ZW XFP specifications

Parameter	Specifications
Line rate (nominal)	10GBASE-ZR 10.3125 Gbit/s ±100 ppm (10 GbE) 10GBASE-ZW 9.95328 Gbit/s ±20 ppm (OC-192)
MTBF	675 000 hours
Distance	Up to 80 km
Link optical power budget	24 dB
Maximum transmitter and dispersion penalty	3.0 dB at 80 km (G.652 fiber)
Transmitter characteristics	
Center wavelength range	1530 to 1565 nm; nominal 1550 nm
Side mode suppression ratio (minimum)	30 dB
Average launch power	0 to 4.0 dBm
Optical modulation amplitude (minimum)	-1.7 dBm
Average launch power of OFF transmitter (maximum)	-30 dBm
Extinction ratio (ER)	minimum 3.5 dB end of life maximum 7.0 dB start of life
$RIN_{12}OMA$ (maximum)	-128 dB/Hz
Maximum optical return loss tolerance	-26 dB
Maximum transmitter reflectance	-12 dB
Receiver characteristics	
Wavelength range	1280 to 1575 nm. Sensitivity specified for 1530 to 1565 nm.
Signaling speed (nominal)	10GBASE-ZR 10.3125 Gbit/s ± 100 ppm (10 GbE) 10GBASE-ZW 9.95328 Gbit/s ± 100 ppm (OC-192)
Maximum average receiver sensitivity	-24 dBm
Maximum receive power (for BER 10^{-12} and 9 dB ER)	-7.0 dBm
Maximum average receive power for damage	5.0 dBm

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Parameter	Specifications
Receiver reflectance (maximum)	-27 dB
Receive electrical 3 dB upper cutoff frequency	9.3 GHz

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Nortel Ethernet Routing Switch 4500 Series

Installation — SFPs and XFPs

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